pixel value at a necessary position within each reference image, and either interpolation or extrapolation. For calculating determined values from a plurality of pixel values obtained from the respective reference images, there are other alternative methods than a simple averaging method such as a weighted average method and a method for calculating by using a coefficient of a low-pass filter. Although description has been made of the case for determining motion compensation based on a field of an interlace signed in the present embodiment, it is needless to mention that the effect of the determination does not change if a frame is used as a base or a noninterlace image is used as a base as shown in the second and third embodiments respectively.

According to the present invention, as is clear from the above-described embodiments, a time position of a reference image is corrected by using a motion vector as required so that a plurality of pieces of reference images sampled at different times according to detected motion at certain time intervals of a block unit including at least one pixel become images at times separated from the input image by the above time intervals, so that it is possible to obtain a plurality of pieces of images at positions separated by the above time intervals from the input image. By combining the plurality of pieces of images together, a reference image of high pixel density can be obtained and a pixel value at a position which has been compensated by the detected motion is calculated by using the reference image of high pixel density, so that the calculated pixel value is used as a determined value. Thus, there is an effect that it is possible to determine motion compensation of an image at a very high level of precision.

Further, according to the present invention, a vector for correcting a time position of the above reference image can be calculated based on motion detected at a certain time interval, which does not require a detection again of a motion vector for correcting the time position, so that this has an effect that motion compensation at a high precision level can be ensured. Further, since an interlace signal can be used as an input signal and a reference image can be in two fields of a certain frame, the above determination of motion compensation can be applied to a frame image, thus ensuring a determination, at a high precision level, of motion compensation based on a frame.

Further, since the same value can be used for a block of each input image among blocks of a plurality of pieces of input images, each block having its whole or part of spatial position superposed with that of the other blocks, as a move detected at a certain time interval of a block unit including at least one pixel, it is not necessary to carry out a plurality of detections of moves of many block in a plurality of input images so that there is an effect that a determination of motion compensation at a high precision level can be ensured.

We claim:

1. A method of determining motion compensation for an input image from motion vectors between the input image and a plurality of reference images, said method comprising the steps of:

(a) calculating a motion vector MV1 between the input image and one reference image of said plurality of reference images [from a motion of at least one block unit] at a second set time interval $T_2$ between the input image and said one reference image[, said at least one block unit being a part of said input image and comprising a plurality of pixels];

(b) providing a motion vector MV2 between at least two reference images of the plurality of reference images at

a first set time interval $T_1$, which is parallel to the motion vector MV1 at the second set time interval $T_2$ and different in magnitude from the motion vector MV1 at the second set time interval $T_2$ by a value determined by $MV1 \cdot T_1/T_2$; and

(c) calculating the motion compensation of the input image from both of (i) the motion vector MV1 between the input image and said one reference image and (ii) the motion vector MV2 between the at least two reference images of the plurality of reference images.

2. A method of determining motion compensation for an input image from a motion vector between the input image and a plurality of reference images, said method comprising the steps of:

(a) detecting a motion vector MV1 between the input image and one reference image R1 of said plurality of reference images at a second set time interval $T_2$;

(b) providing a motion vector MV3 between the reference image R1 and another reference image R2 of said plurality of reference images at a first set time interval $T_1$, said motion vector MV3 being parallel to the motion vector MV1 and different in magnitude from the motion vector MV1 by a value determined by $MV1 \cdot T_1/T_2$;

(c) obtaining a motion vector MV2 between the input image and the another reference image R2 at a third set time interval $T_3$ from a sum of the motion vector MV1 and the motion vector MV3, and calculating respective pixels corresponding to the motion vector MV1 and the motion vector MV2 from pixels of the reference image R1 and the reference image R2 corresponding to the motion vector MV1 and the motion vector MV2 or from pixels positioned peripherally of the pixels of the reference image R1 and the reference image R2; and

(d) calculating motion-compensated pixel values from the calculated pixels of the reference images.

3. A method of obtaining a motion-compensated image from a motion vector between the motion-compensated image and a plurality of reference images, said method comprising the steps of:

(a) obtaining a motion vector MV1 between the motion-compensated image and one reference image R1 of said plurality of reference images at a second set time interval $T_2$;

(b) providing a motion vector MV3 between the reference image R1 and another reference image R2 of said plurality of reference images at a first set time interval $T_1$, which is parallel to the motion vector MV1 and different in magnitude from the motion vector MV1 by a value determined by $MV1 \cdot T_1/T_2$;

(c) obtaining a motion vector MV2 between the motion-compensated image and said another reference image R2 at a third set time interval $T_3$ from a sum of the motion vector MV1 and the motion vector MV3, and calculating respective pixels corresponding to the motion vector MV1 and the motion vector MV2 from pixels of the reference image R1 and the reference image R2 corresponding to the motion vector MV1 and the motion vector MV2 or from pixels positioned peripherally of the pixels of the reference image R1 and the reference image R2; and

(d) calculating motion-compensated pixel values from the calculated pixels of the reference images to obtain the motion-compensated image.

* * * * *

4. A method of obtaining a motion-compensated image, said method comprising the steps of:

(a) obtaining a first motion vector MV1 between the motion-compensated image and one reference image R1 of a plurality of reference images at a second set time interval T2 between the motion-compensated image and said one reference image R1;

(b) calculating a second motion vector MV2 between the motion-compensated image and another reference image R2 of said plurality of reference images at a first set time interval T1 between the motion-compensated image and said another reference image R2, said second motion vector MV2 being parallel to said first motion vector MV1 and having a magnitude satisfying the relation $MV2=MV1\cdot(T1/T2)$;

(c) calculating first pixel values of said one reference image R1 from pixels which are neighbors of positions corresponding to said first motion vector MV1 and calculating second pixel values of said another reference image R2 from pixels which are neighbors of positions corresponding to said second motion vector MV2, wherein said reference images R1 and R2 are such that a motion vector MV3 between said reference images R1 and R2 has a mathematical relationship with said first and second motion vectors MV1 and MV2 in which said motion vector MV3 is parallel to and different in value from each of said first and second motion vectors MV1 and MV2; and

(d) calculating motion-compensated pixel values of said motion-compensated image from said first and second pixel values calculated in step (c) to obtain said motion-compensated image.

5. A method of obtaining a motion-compensated image, said method comprising the steps of:

(a) obtaining a first motion vector MV1 between the motion-compensated image and one reference image R1 of a plurality of reference images at a second set time interval T2 between the motion-compensated image and said one reference image R1;

(b) calculating a second motion vector MV2 between the motion-compensated image and another reference image R2 of said plurality of reference images at a first set time interval T1 between the motion-compensated image and said another reference image R2, said second motion vector MV2

being parallel to said first motion vector MV1 and having a magnitude satisfying the relation $MV2=MV1 \cdot (T1/T2)$;

(c) calculating first pixel values of said one reference image R1 from pixels which are neighbors of positions corresponding to said first motion vector MV1 and calculating second pixel values of said another reference image R2 from pixels which are neighbors of positions corresponding to said second motion vector MV2, wherein said reference images R1 and R2 are previous to said motion-compensated image in a time sequence; and

(d) calculating motion-compensated pixel values of said motion-compensated image from said first and second pixel values calculated in step (c) to obtain said motion-compensated image.

6. A method in accordance with claim 4, wherein said reference images R1 and R2 are previous to said motion-compensated image in a time sequence.